भारतीय मानक

Indian Standard

IS 6072 : 2023

दीवारों के लिए ऑटोक्लेवित प्रबलित कोशिकीय कंक्रीट स्लैब — विशिष्टि

(पहला पुनरीक्षण)

Autoclaved Reinforced Cellular Concrete Wall Slabs — Specification

(First Revision)

ICS 91.060.10; 91.100.30

भारतीय मानक ब्यूरो
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Prefabricated Construction Sectional Committee, CED 32

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Prefabricated Construction Sectional Committee had been approved by the Civil Engineering Division Council.

A series of national standards on the cellular concrete were formulated earlier, so as to provide standard products for the construction of buildings. Cellular concrete was a class of material, which was developed commercially abroad and then in the country. Considering the importance, standards for cellular concrete floor, roof and wall elements were developed to guide both the manufacturers and the users of these elements.

This standard was first formulated in 1971 covering therein the physical properties, other general requirements for the precast autoclaved reinforced cellular concrete wall slabs. The specification gives structural requirements essential to ensure safe performance of slabs under vertical and horizontal loading without specifying the detailed method of design. Earlier, the concerned sectional committee was of the opinion that the detailed method for the design of these members was not within the scope of the specification, and moreover, the acceptability of the design methods for such products, whether based on elastic theory or on load factor method, was not fully established then even in countries having considerable experience in the manufacture and use of this type of concrete. It is well established that as in other mass produced precast concrete products, the detailed design of the units lies in the hands of the manufacturer rather than the user. Therefore, it was felt then that from the user's angle, it would be more useful if the requirements regarding the performance and loading coupled with acceptance tests are included in the specification. Some requirements in line with the above thinking were stipulated in the standard in the 1971 version.

In this revision of the standard, the following changes/modifications have been incorporated:

a) A new clause for requirements of Aluminium powder has been added;
b) Criteria for minimum reinforcement has been added;
c) All the three amendments issued to the previous version of the standard have been incorporated;
d) Efforts have been made to coordinate with standards and practices prevailing in different countries; and
e) Existing cross references have been updated and new ones have been made.

This standard contributes to the United Nations Sustainable Development Goal 9: ‘Industry, Innovation and Infrastructure’, particularly its target to develop quality, reliable, sustainable and resilient infrastructure, and also promote inclusive and sustainable industrialization.

The composition of the Committee responsible for formulation of the standard is given in Annex C.

For the purpose of deciding whether a particular requirement of this standard is complied with the final, observed or calculated value, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 2022 'Rules for rounding off numerical values (*second revision*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

AUTOCLAVED REINFORCED CELLULAR CONCRETE WALL SLABS — SPECIFICATION

(First Revision)

1 SCOPE

This standard covers the requirements for autoclaved reinforced cellular concrete wall slabs, having density above 450 kg/m^3 and up to 1 000 kg/m^3.

2 REFERENCES

The standards listed in Annex A contain provisions which, through reference in this standard, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of these standards.

3 TERMINOLOGY

For the purpose of this standard, the terms shall have the meaning as mentioned below:

3.1 Autoclaved Cellular Concrete — The material conforming to this specification and consisting of an inorganic binder (such as lime or cement or both) in combination with a finely ground material containing silicic acid (such as sand, fly ash, GGBS or in combination), gas generating material (for example, aluminium powder); water and harmless additives (optional); and steam cured under high pressure in autoclaves.

3.2 Design Horizontal Load — The permissible superimposed horizontal load, such as wind load which the wall slab can safely carry under normal service conditions in the wall.

4 MATERIALS

The major materials for the manufacture of autoclaved reinforced cellular concrete wall slabs shall be as in **4.1** to **4.6**.

4.1 Cement

Cement shall conform to IS 269 or IS 455 or IS 1489 (Part 1) or IS 1489 (Part 2).

4.2 Lime

Lime shall satisfy the requirements for class C lime specified in IS 712.

4.3 Sand

Sand (fine aggregate) shall be finely ground siliceous material conforming to the requirements of fine aggregates in IS 383 except for the grading and the requirements as given below:

Sl No.	*Property*	*Requirement* (*By weight*)
(1)	(2)	(3)
i)	Silt content	3 percent, *Max*
ii)	Humus	3 percent, *Max*
iii)	SiO_2 content	80 percent, *Min*
iv)	Chloride	0.025 percent, *Max*
v)	Loss of ignition	5 percent, *Max*
vi)	Mica	In accordance with IS 383

4.4 Fly Ash

Fly ash shall conform to IS 3812 (Part 1) or IS 3812 (Part 2).

4.5 Granulated Blast Furnace Slag

Ground granulated blast furnace slag (GGBS) shall be in ground form conforming to IS 16714 and ultrafine ground granulated blast furnace slag (UGGBS) shall conform to IS 16715.

4.6 Water

Water shall conform to the requirements given in IS 456.

4.7 Reinforcement

Reinforcement shall be any of the following:

a) Mild steel and medium tensile steel bars conforming to grade I of IS 432 (Part 1);
b) High strength deformed steel bars and wires conforming to IS 1786;
c) Hard-drawn steel wire conforming to IS 432 (Part 2);
d) Welded wire fabric conforming to IS 1566; and
e) Stainless steel bars conforming to IS 16651.

4.7.1 Spot welding may be adopted for keeping the reinforcement in position.

4.8 Aluminium Powder — The Aluminium powder shall be manufactured using ingots of purity more than 99.7 percent. Manufacturing is generally done by atomizing molten Aluminium liquid, followed by dry ball milling process. The aluminium powder shall preferably conform to the following requirements:

Sl No. (1)	*Characteristics* (2)	*Desired limits* (3)
i)	Sieve analysis: Passing through 45 µm	65 percent – 75 percent
ii)	Apparent density (loose pouring)	0.130 g/cc – 0.200 g/cc
iii)	Surface area (blaines)	11 000 cm^2/g – 13 000 cm^2/g
iv)	Active aluminium content	90 percent, *Min*
v)	Miscibility in water	Miscible
vi)	Gas evolution at 25 °C for 0.07 g of Al Powder in 400 ml of 2 percent CaO solution within 16 min	75 ml, *Min*
vii)	Particle diameter corresponding to 50 percent finer on the grain size curve, D50	40 µm – 50 µm

4.8.1 Aluminium powder having specification other than those mentioned in **4.8** may also be used according to the specifications suggested by the wall slabs manufacturer.

NOTE — While approving aluminium powder, final test of products like dry density, compressive strength shall be ensured for acceptance/rejection.

5 CLASSIFICATION AND DESIGNATION

5.1 Classification

Autoclaved reinforced cellular concrete wall slabs shall be classified into the following five classes on the basis of their oven dry density (without reinforcement) and the compressive strength (*see* Table 1). Out of these, class E slab shall only be used for non-structural purposes.

5.2 Designation

The wall slabs shall be designated by indicating the compressive strength in N/mm^2 horizontal load bearing capacity (design load) in N/mm^2, and the height (mm), width (mm) and thickness (mm) respectively (for example, *see* **5.2.1** and Fig. 1).

5.2.1 *Wall Slab*

The designation of a class A Wall Slab having a compressive strength of 7 N/mm^2 and horizontal load bearing capacity of 10 N/mm^2 with gross density 850 kg/m^3 to 1 000 kg/m^3, *h* mm high, *b* mm wide and *t* mm thick shall be marked as *WS/7/10* × *h* × *b* × *t*.

Table 1 Compressive Strength and Thermal Conductivity)

(*Clause* 5.1)

Sl No.	**Class of Slab**	**Oven Dry Density** kg/m^3	**Compressive Strength,** *Min* (N/mm^2)	**Thermal Conductivity in Air-dry Condition,** *Max* (K cal/m/h/°C)
(1)	(2)	(3)	(4)	(5)
i)	Class E	450 – 550	2.0	0.18
ii)	Class D	550 – 650	3.5	0.21
iii)	Class C	650 – 750	5.0	0.26
iv)	Class B	750 – 850	6.0	0.32
v)	Class A	850 – 1 000	7.0	0.36

NOTE — The compressive strength shall be the average of three sample cubes tested and the lowest individual value shall not be less than 85 percent of the required average value.

6 SIZES

6.1 The dimensions of autoclaved reinforced cellular concrete wall slabs shall be arrived at keeping in view the structural design requirements and the considerations relating to modular co-ordination. The preferred dimension of the wall slab shall be as below (*see* Fig. 1):

a) Height 1 000 to 6 000 mm
b) Width 600 mm
c) Thickness 150 to 250 mm with increments of 25 mm

6.1.1 Sizes other than those specified in **6.1** may also be used by mutual agreement between the purchaser and the supplier.

6.2 Tolerances

Tolerances for dimensions shall be as follows:

a) Below and up to 500 mm ± 2 mm
b) Over 500 mm ± 5 mm

6.3 Form Tolerances

The form tolerances (*see* Fig. 2) for the wall slabs shall be as in Table 2.

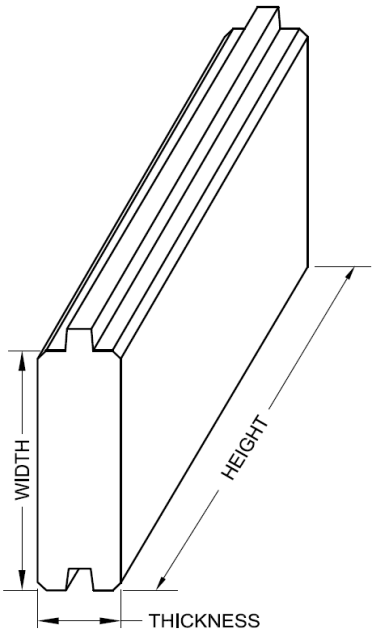

FIG. 1 ILLUSTRATION OF DIMENSIONS OF WALL SLAB

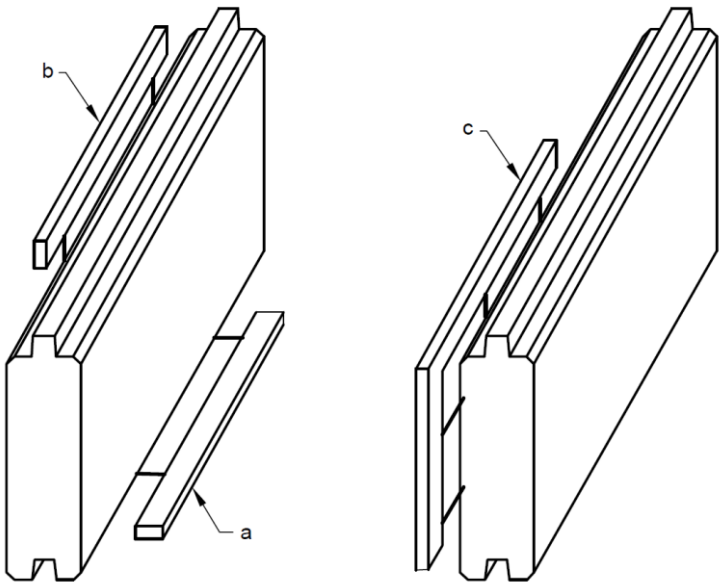

FIG. 2 ILLUSTRATION OF TOLERANCES OF WALL SLAB

Table 2 Form Tolerances for Wall Slabs
(C*lause* 6.3)

Sl No.	Details	Tolerance mm				
		Distance Between Measuring Pins (m)				Entire Length
		0.25	1.0	2.0	0.5	
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	Flatness:					
	a) Warp	± 2	± 4	± 6	–	–
	b) Torsion	–	–	–	–	0.1 Percent, *Max*
ii)	Edge straightness (does not apply to end edges):					
	a) In a plane perpendicular to the plane of the unit (*see a* in Fig. 2)	± 1	± 2	± 3	–	–
	b) In the plane of the unit (*see b* in Fig. 2)	–	–	–	–	± 3
iii)	Squareness of angle between adjacent faces (*see c* in Fig. 2)	–	–	–	± 5	–

7 MANUFACTURE AND FINISH

7.1 Reinforcement

Reinforcements shall be located in the unit according to the design. The reinforcement shall be effectively protected against corrosion by suitable coating. The protective coating shall not be damaged during placing and casting, autoclavation and other manufacturing processes. The applied protective coating shall satisfy the requirements given in IS 6441 (Part 4). In addition to protecting the reinforcement against corrosion, it shall be ensured that the cellular concrete cover to the steel shall not be less than that necessary to attain the required fire resistance grading and in any case not less than 10 mm.

7.1.1 The main reinforcement for structural slab system shall conform to the requirements given in IS 456. Minimum number of bars shall be provided as follows:

a) at least 3 bars for spans up to 2 m;
b) at least 4 bars for spans up to 5 m; and
c) at least 5 bars for spans longer than 5 m.

For wider spans, a correspondingly larger number of bars shall be placed.

7.1.2 The reinforcement of the tension and compression zones shall lie after the setting of the concrete in such a way that the concrete cover is at least 10 mm and the static effective height shall in no case fall short by more than 5 mm.

7.2 Formation of Cells of Cellular Concrete

The aerated structure of the cells of the cellular concrete slabs are formed by generation of a gas by chemical action with the mix prior to hardening with the aid of suitable chemical foaming agents and mixing devices. The cells in the slab shall be distributed evenly throughout its volume.

7.2.1 *Method of Autoclavation*

After accurate proportioning, the raw materials are mixed in a mechanical mixer to form a mass of uniform colour. Water and aluminium powder in accurately measured quantity shall then be mixed to the mix and the final mix is then poured into the moulds quickly. Due to chemical reaction between the binding material and water, the mass over-grows over the edges and expands like a dough and simultaneously hardens. When the chemical reaction is completed as indicated by cessation of the growth phenomenon, the portion bulging out of the

mould is cut off to obtain the block of the desired size and shape. The mould is then introduced into the autoclave, where it is subjected to steam pressure of 0.7 N/mm^2 and temperature of about 185 °C.

7.3 Finish

7.3.1 The faces of the slabs shall be rectangular, opposite faces shall be parallel and all edges shall be straight. The angle between different faces shall be a right angle. The slabs shall be free from all defects liable to affect adversely their suitability for use.

7.3.2 Each wall slab shall be provided with tongue at one side and groove at the other side to match with the corresponding tongue and groove in the adjacent unit; alternatively, the slab may have a groove at either side matching with the groove in the adjacent unit to permit easy filling with cement mortar, or some other suitable provisions may be made to allow for the transfer of force from unit to unit. The longitudinal edges shall be chamfered.

8 PHYSICAL PROPERTIES

8.1 Autoclaved reinforced cellular concrete wall slabs shall have the properties specified below:

a) Density of element (excluding reinforcement) — It shall be in the range specified in **5.1** when tested in accordance with IS 6441 (Part 1);

b) Drying shrinkage — It shall not be more than 0.09 percent when tested in accordance with IS 6441 (Part 2);

c) Residual water content at the time of delivery to the user — It shall be declared by the manufacturer;

d) Compressive strength and thermal conductivity — They shall be as given in Table 1 (*see* **5.1**) when tested in accordance with IS 6441 (Part 5) and IS 3346, respectively; and

e) Fire resistance — It shall not be less than 2 h when tested in accordance with IS/ISO 834-1.

9 STRUCTURAL REQUIREMENTS

9.1 Loading

The slabs shall be designed for loading in accordance IS 875 (Parts 1 to 5) for the purpose of calculating dead load, the weights of the materials shall be taken as specified in IS 875 (Part 1). However, the dead load of the slab proper shall be assessed in accordance with densities specified in **5.1** plus the weight of reinforcement.

9.2 Design Load and Deflection

The manufacturer shall indicate the horizontal design load (*see* **3.2** and **5.2**) for which the wall slab has been designed. When rested in accordance with the method given in Annex B, the deflection of the slab under the horizontally applied design load shall not be more than 1/300 of the effective span.

9.3 Ultimate Load

The manufacturer shall indicate the ultimate load for the wall slab, which in any case shall not be less than the following:

$$\text{Ultimate load} = 2.5 \times \text{design load}$$

9.3.1 The ultimate load, when tested in accordance with the method given in Annex B, shall not be less than the value indicated in **9.3** and/or not less than the value indicated by the manufacturer.

10 STORAGE AND HANDLING

10.1 Cellular concrete slabs shall be stock-piled on planks or other supports free from contact with the ground. The slabs of different densities and shapes shall be kept in separate stacks. The slabs shall be handled with care according to the instructions of the manufacturer and damaged slabs shall be rejected. Slabs shall not be cut without permission of the designer or engineer-in-charge. Such permission shall be granted, by designer or engineer-in-charge, after finding out the suitability of the slab for the intended purpose and, if necessary, in consultation with the manufacturer.

11 MARKING

11.1 Each slab shall be clearly and permanently marked with the following information:

a) Manufacturer's name and/or trade-mark, if any;
b) Year of manufacture;
c) Batch/control number;
d) Designation; and
e) The words ‘DO NOT CUT’.

11.2 The manufacturer shall provide technical literature containing information on:

a) the design load and the deflection on design load;
b) the ultimate load;

c) residual water content on delivery;
d) the provisions for making holes;
e) the detailed storage and handling instructions (*see* Note); and
f) the thermal conductivity of different classes of products.

NOTE — Unsuitable storage and handling after delivery can cause permanent deformations in the slab, especially with regard to torsion and warp.

11.2.1 *BIS Certification Marking*

Each slab conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act*, 2016 and the Rules and Regulations framed thereunder, and may be marked with the Standard Mark.

12 COST OF TESTS AND MANUFACTURERS CERTIFICATE

12.1 The manufacturer shall arrange to maintain production control measures, so that the wall slabs conform to the requirements of this specification and, if requested, shall supply certificate to this effect to the purchaser or his representative.

12.1.1 In case the slab does not possess the required load-carrying capacity in certain positions, the manufacturer shall mark the slab in a way, which makes clear in what position it would be handled, assembled and used. Slabs which have to be supported or lifted, at special points, during storage or in handling, shall be furnished with necessary markings. Slabs intended for special hole-making shall be marked as to where the holes may be made.

12.2 If the purchaser or his representative requires independent tests, the samples shall be taken before or immediately after delivery, at the option of the purchaser or his representative and the tests shall be carried out in accordance with this specification.

12.3 The manufacturer shall supply free of charge the slabs required for testing.

12.4 Unless otherwise specified in the enquiry or order the cost of the test shall be borne as follows:

a) By the manufacturer in the event of the results showing that the slabs do not conform to this specification; or
b) By the purchaser in the event of the results showing that the slabs conform to this specification.

13 SAMPLING AND CRITERIA FOR CONFORMITY

13.1 Unless otherwise agreed to between the purchaser and the supplier the method of drawing representative samples of the slabs and the criteria for conformity shall be as given in **13.2** to **13.5.2**.

13.2 Lot

In any consignment, all slabs of the same class (*see* **5.1**) and size and from the same batch of manufacture shall be grouped together into a minimum number of groups of 500 slabs or part thereof. Each such group shall constitute a lot.

13.3 From each lot a sample of ten slabs shall be selected at random. In order to ensure randomness of selection, all the slabs in the lot may be arranged in an aerial order starting from any random slab, every r^{th} slab may be selected till ten slabs are included in the sample, r being the Integral part of $N/10$, where N is the lot size.

13.4 Number of Tests

13.4.1 All the ten slabs shall be checked for dimensions and inspected for visual defects.

13.4.2 Out of the ten slabs, two slabs shall be subjected to the test for design load deflection and cracking load test, the sample from these two slabs after the design load deflection and ultimate load test shall be tested for compressive strength (two samples); density (two samples); drying shrinkage (two samples); and residual water content (one sample). One slab shall be subjected to test for thermal conductivity.

13.5 Criteria for Conformity

The lot shall be considered as conforming to requirements of the specification, if the conditions mentioned in **13.5.1** to **13.5.2** are satisfied.

13.5.1 *Dimensions and Visual Defects*

The number of slabs with dimensions outside the tolerance limit and/or with visual defects among ten slabs inspected shall be not more than one. If the number of such slabs exceeds one, all slabs in the lot shall be tested for these requirements and those not satisfying the requirements shall be rejected.

13.5.2 *Other Tests*

All the samples tested for other tests shall satisfy the requirements of the concerned test. If one or more

samples fail, twice the number of samples originally tested shall be selected from the concerned lot and subjected to the test. If there is no failure among these samples, the lot shall be considered to have satisfied the requirements of this test.

ANNEX A
(*Clause 2*)

LIST OF REFERRED STANDARDS

IS No.	*Title*
IS 44 : 1991	Iron oxide pigments for paints — Specification (*second revision*)
IS 54 : 1988	Specification for green oxide of chromium for paints (*second revision*)
IS 55 : 1970	Specification for ultramarine blue for paints (*first revision*)
IS 56 : 1993	Prussian blue (iron blue) for paints — Specification (*second revision*)
IS 269 : 2015	Ordinary Portland cement — Specification (*sixth revision*)
IS 383 : 2016	Coarse and fine aggregate for concrete — Specification (*third revision*)
IS 411 : 2020	Titanium dioxide, anatase, for paints — Specification (*fourth revision*)
IS 432 (Part 1) : 1982	Specification for mild steel and medium tensile steel bars and hard-drawn steel wire for concrete reinforcement: Part 1 Mild steel and medium tensile steel bars (*third revision*)
IS 432 (Part 2) : 1982	Specification for mild steel and medium tensile steel bars and hard-drawn steel wire for concrete reinforcement: Part 2 Hard-drawn steel wire (*third revision*)
IS 455 : 2015	Portland slag cement — Specification (*fifth revision*)
IS 456 : 2000	Plain and reinforced concrete — Code of practice (*fourth revision*)
IS 712 : 1984	Specification for building limes (*third revision*)
IS 875	Code of practice for design loads (other than earthquake) for buildings and structures:
(Part 1) : 1987	Dead loads — Unit weights of building materials and stored materials (*second revision*)
(Part 2) : 1987	Imposed loads (*second revision*)
(Part 3) : 2015	Design loads (other than earthquake) for buildings and structures — Code of practice: Part 3 Wind loads (*third revision*)
(Part 4) : 2021	Snow loads (*third revision*)
(Part 5) : 1987	Special loads and load combinations (*second revision*)
IS 1489	Portland pozzolana cement — Specification:
(Part 1) : 2015	Fly ash based (*fourth revision*)
(Part 2) : 2015	Calcined clay based (*fourth revision*)
IS 1566 : 1982	Specification for hard-drawn steel wire fabric for concrete reinforcement (*second revision*)
IS 1786 : 2008	High strength deformed steel bars and wires for concrete reinforcement — Specification (*fourth revision*)
IS 3346 : 1980	Method for the determination of thermal conductivity of thermal insulation materials (two slab, guarded hot-plate method) (*first revision*)
IS 3574 (Part 1) : 1965	Specification for organic pigments for paints: Part 1 Azo pigments (toluidine red, chlorinated p-nitroaniline red, arylamide yellow, and para red)

IS No.	*Title*
IS 3574 (Part 2) : 2000	Organic pigments for paints — Specification: Part 2 Phthalocyanines (*first revision*)
IS 3812	Pulverized fuel ash — Specification:
(Part 1) : 2013	For use as pozzolana in cement, cement mortar and concrete (*third revision*)
(Part 2) : 2013	For use as admixture in cement mortar and concrete
IS 6441	Methods of test for autoclaved cellular concrete products:
(Part 1) : 1972	Determination of unit weight or bulk density and moisture content
(Part 2) : 1972	Determination of drying shrinkage
(Part 4) : 1972	Corrosion protection of steel reinforcement in autoclaved cellular concrete
(Part 5) : 1972	Determination of compressive strength
IS 9788 : 1981	Specification for titanium dioxide, rutile for paints
IS 15658 : 2021	Concrete paving blocks — Specification (*first revision*)
IS 16651 : 2017	High strength deformed stainless steel bars and wires for concrete reinforcement — Specification
IS 16714 : 2018	Ground granulated blast furnace slag for use in cement, mortar and concrete — Specification
IS 16715 : 2018	Ultrafine ground granulated blast furnace slag — Specification
IS/ISO 834-1 : 1999	Fire-resistance tests elements of building construction: Part 1 General requirements

ANNEX B

(*Clauses* 9.2 *and* 9.3.1)

DEFLECTION AND ULTIMATE LOAD TEST FOR AUTOCLAVED REINFORCED CELLULAR CONCRETE WALL SLABS

B-1 SELECTION

B-1.1 The sample shall be selected in accordance with **13**.

B-1.2 The sample at the time of testing shall have residual water content as indicated in **8.1** (c), but it shall not be less than 10 percent by weight.

B-2 DEFLECTION

B-2.1 The slab shall be placed on two supports so that the face surrounded by the length and breadth of the slab is horizontal and the centre-to-centre distance between the supports (called effective span) is equal to the length of the slab.

B-2.2 The slab shall be loaded for half an hour with half the design load; this load being applied vertically and uniformly distributed all over the slab.

B-2.3 After half an hour without removing the load applied in **B-2.2**, the balance half of the full design load is applied in the same manner as in **B-2.2**.

B-2.4 The total design load shall be kept in position for half an hour after which the sample shall be examined for any cracking and maximum deflection at mid-span of the slab for the full load (design imposed load + self-weight of slab) shall be measured.

B-2.5 If the sample has cracked or if the maximum measured deflection is more than 1/300 of the effective span, the sample shall be considered to have failed the test.

B-3 ULTIMATE LOAD

Unless cracks have occurred under the design load, the sample as loaded in **B-2.4** shall be loaded further in suitable increments of load till the slab fails. The total load at failure shall be considered as the ultimate load.

ANNEX C

(*Foreword*)

COMMITTEE COMPOSITION

Prefabricated Construction Sectional Committee, CED 32

Organization	*Representative(s)*
L&T Construction, Chennai	SHRI K. SENOU **(*Chairperson*)**
Anna University, Chennai	DR K. P. JAYA DR R. VIDJEAPRIYA (*Alternate*)
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Bharat Heavy Electrical Limited, New Delhi	SHRI T. AARUYIR YOGAA SHRI K. V. LAKSHMI NARAYANAN (*Alternate*)
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Building Materials and Technology Promotion Council, New Delhi	DR SHAILESH KUMAR AGRAWAL
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City and Industrial Development Corporation of Maharashtra Limited, Navi Mumbai	REPRESENTATIVE
Concrete Curations Pvt Ltd, Coimbatore	SHRI DINESH KUMAR BHANDARI
Confederation of Real Estate Developers Association of India, New Delhi	SHRI HARI KRISHNA BHANUSREE
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CSIR - Structural Engineering Research Centre, Chennai	DR K.N. LAKSHMIKANDHAN DR K. SIVASUBRAMANIAN (*Alternate* I) DR P. PRABHA (*Alternate* II)
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Engineers India Limited, New Delhi	SHRI ANISH KUNDU

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JMC Projects (India) Limited, Mumbai	SHRI RAJ KUMAR PILLAI SHRI NIDHI GUPTA (*Alternate*)
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Ministry of Housing & Urban Affairs, New Delhi	REPRESENTATIVE
Mumbai Metropolitan Region Development Authority, Mumbai	REPRESENTATIVE
National Council for Cement and Building Materials, Ballabgarh	SHRI P. N. OJHA SHRI AMIT TRIVEDI (*Alternate* I) SHRI MANISH MANDRE (*Alternate* II)
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NTPC Limited, New Delhi	SHRI ANIL J MORCHALE SHRI SUPARNA BISWAS (*Alternate*)
Shirish Patel and Associates Consultants Pvt Limited, Mumbai	REPRESENTATIVE

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